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PENSOFT

First report of the rare morid *Laemonema robustum* (Gadiformes) from the Southwestern Atlantic

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Abstract

The poorly known morid *Laemonema robustum* Johnson, 1862, is reported for the first time from Brazilian marine waters. Morphometric characters are compared with published works and selected vouchers. The known Atlantic Ocean range of the species is extended to the Southwestern Atlantic, thousands of kilometers from previous records.

Keywords

Brazil, deep-sea, Moridae, range extension, robust mora.

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Introduction

The family Moridae includes 18 genera and 106 species (Fricke et al. 2019b). *Laemonema robustum* Johnson, 1862 is the type species of the morid genus *Laemonema* Günther, 1862 (Meléndez and Markle 1997; Fricke et al. 2019a). This genus was diagnosed by Meléndez and Markle (1997) as: a morid with interorbital width equal to or shorter than orbit diameter; six to nine rays in first dorsal fin, with first dorsal ray almost always beneath skin; second dorsal fin with 40–73 rays; anal fin with 41–71 rays; teeth on vomer; caudal peduncle small and thin; chin barbel usually present; adults with two well-developed pelvic rays and two to nine small inner rays under the skin; photophores absent; known juveniles without numerous vertical bars on sides. Twelve to fourteen species of the genus are currently recognized (Cohen et al. 1990; Meléndez and Markle 1997; Fricke et al. 2019A, see Discussion), of which six occur in the Atlantic Ocean: *Laemonema barbatulum* Goode & Bean, 1883, *Laemonema goodebeanorum* Meléndez & Markle, 1997, *Laemonema laureysi* Poll, 1953, *Laemonema melanurum* Goode & Bean, 1896, *Laemonema robustum*, and *Laemonema yarrelli* (Lowe, 1838). In the Western Atlantic four species occur—*L. barbatulum*, *L. goodebeanorum*, *L. melanurum* and *L. robustum*—but from the Southwestern Atlantic only *L. barbatulum* and *L. goodebeanorum* have ever been reported (Edwards 1990; Meléndez and Markle 1997; Menezes and Figueiredo 2003; Melo et al. 2010).

Deep-sea research off Brazil has been sparse, but recent exploratory fishing efforts have resulted in several new records, range extensions, and descriptions of new species from the southwestern Atlantic (e.g., Bernardes et al. 2005; Mincarone et al. 2008; Carvalho-Filho et al. 2009, 2010, 2011; Carvalho-Filho and

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Paiva 2017; Pires et al. 2019). Several of these records resulted from a research project conducted by the Projeto TAMAR (Projeto Tartaruga Marinha, the Brazilian environmental institution that protects and studies sea turtles) team, which aims to evaluate the efficiency of the circle hook in pelagic and bottom longline fisheries (Carvalho-Filho et al. 2009). In this paper, we provide the first record of *Laemonema robustum* from the Southwestern Atlantic, extending its range in thousands of kilometers from its previous known occurrences in the Atlantic Ocean (Gulf of Mexico, Saint Helena Island and Eastern Atlantic).

Methods

Measurements and meristics follow Meléndez and Markle (1997). Data obtained from the specimen of *Laemonema robustum* of this study match the measurements and meristic data provided by Johnson (1862), Günther (1862), Meléndez and Markle (1997), González et al. (2008), and Iwamoto and Cohen (2016). The specimen was collected in 2008 by the deep-sea fishing exploratory crew of the TAMAR Project off Bahia. The specimen was fixed in formalin, preserved in ethanol 70%, and deposited at MZUSP collection. Measurements were taken with a manual caliper to the nearest tenth of mm; length of specimen is given in standard length (SL) and head length is abbreviated as HL. Institutional abbreviations follow Sabaj (2016).

Results

***Laemonema robustum* Johnson, 1862**
Figure 1, Table 1

English common names: Robust mora; robust cod; robust codling.
Proposed Portuguese common name: Abrótea robusta.

New record (northeastern Brazil; Fig. 2). 1 specimen • MZUSP 125605 (342.0 mm SL) off Praia do Forte, Mata de São João, Bahia, 12°38′85″S, 037°55′63″W, 400m, circle-hook deepwater longline, col. G. Marcovaldi-TAMAR, 3 Mar., 2008.

Additional material examined (eastern Atlantic). 1 specimen • BMNH 1864.8.24.2, 1 spec. (265.1 mm SL), Madeira, donated by J. Johnson, 1864.

Laemonema barbatulum (USA). 6 specimens • MCZ 156804, 2 spec. (155.7–197.4 mm SL), R/V Albatross IV, New England, 39°31′N, 072°18′W, Station 100, 343 m, 30 Sep., 1998 • MCZ 91725, 2 spec. (134.0–147.8 mm SL), R/V Delaware II, Mid-Atlantic Bight, 38°10′N, 073°47′W, 119 m, 28 Feb., 1989 • MCZ 25841 Syntypes, 2 spec. (76.3–160.4 mm SL), USCSS Blake Expedition, 32°18′N, 78°43′W, 225 fms, Jul., 1880.

Laemonema goodebeanorum (Brazil). 22 specimens • MZUSP 86349, 1 spec. (194.1 mm SL), R/V Soloncy Moura, Projeto Revizee Score Sul, sta. 1249, off SE Brazil, 24°02′12″S, 043°04′44″W, 26 Apr., 2002 • MZUSP 86598, 3 spec. (162.0–196.8 mm SL), R/V Atlântico Sul, Projeto Revizee Score Sul, off S Brazil, 32°04′35″S, 050°03′08″W, 500 m, 5 Apr., 2002 • MZUSP 86353, 4 spec. (18.5.2–213.9 mm SL), R/V Soloncy Moura, Projeto Revizee Score Sul, off SE Brazil, 27°10′43″S, 046°45′38″W, 495–505 m, Dec. 2000 • MZUSP 86351, 9 spec. (146.8–234.2 mm SL), R/V Soloncy Moura, Projeto Revizee Score Sul, off SE Brazil, 27°08′09″S, 046°39′20′W, 475–491 m, Dec., 2000 • MZUSP 86354 4 spec. (209.0–246.8 mm SL), R/V Soloncy Moura, Projeto Revizee Score Sul, off SE Brazil, 27°08′19″S, 046°30′45″W, Dec., 2000 • MZUSP 78253, 1 spec. (204.1 mm SL), R/V Atlântico Sul, Equipe Revizee, sta. 6014, off S Brazil, 30°34′20″S, 048°09′18″W, 794 m, 27 Nov., 1999. (Bermuda) 3 specimens • MCZ 150649, 1 spec. (78.2 mm SL), R/V Endeavor 238, NE Bermuda, Sargassum Sea, 32°35′N, 064°04′W, 100–1250 m, 14 Jun., 1992. (USA) 2 specimens • MCZ 53989 2 spec. (166.8–200.4 mm SL), South New England, 39°20′N, 072°18′W, 260–342 m, col. R.L. Haedrich, 28 Feb., 1973.

Laemonema longipes (Japan) 3 specimens • BMNH 1991.7.12.9-11, 3 spec. (165.2–214.8 mm SL), off Sanriku (Tohoku), 37°51′24″N, 141°54′19″E, 440 m, col. H. Endo 17 May, 1990.

Laemonema melanurum (USA) 2 specimens • MCZ 98307, 1 spec. (80.0 mm SL), Woods Hole Oceanographic Institution, S New England, 39°45′N, 071°00′W, 400–500 m, 19 Aug., 1981 • MCZ 156749, 1 spec. (75.2 mm SL), RV Delaware II, sta. 35°07′N, 075°05′W, 472–523m, 13 Feb., 1999.

Lepidion sp. (Eastern Atlantic). 10 specimens • BMNH 2016.3.10.54-64, 10 spec. (84.7–172.1 mm SL), R.R.S. Discovery Cruise, Cape Verde Plateau, off Mauritania, 18°45′00″N, 016°46′00″ W, 352 m, 6 Feb., 1968; labeled as "*Laemonema* (?) *robustum*".

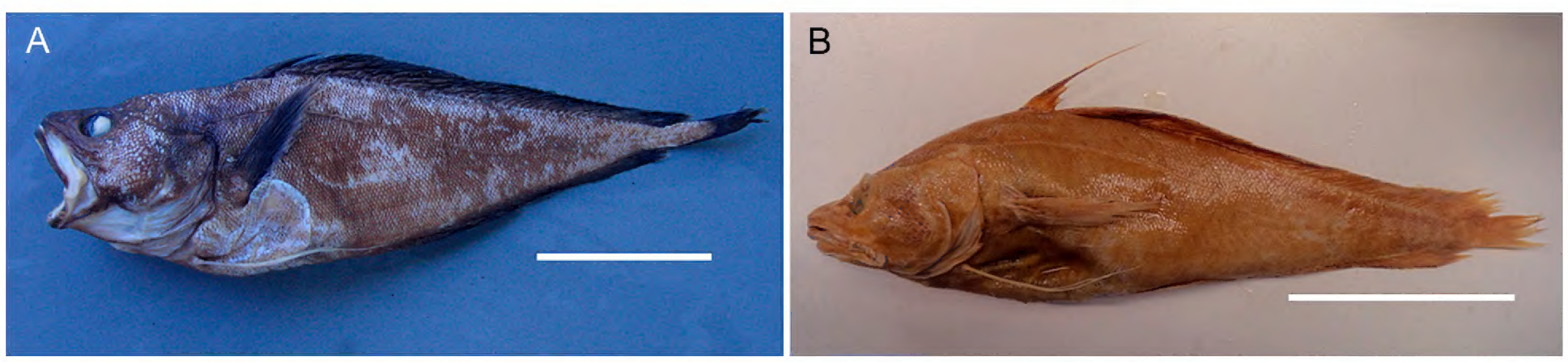

Figure 1. *Laemonema robustum*. **A.** MZUSP 125605 (342.0 mm SL). **B.** BMNH 1864.8.24.2 (265.1 mm SL). Scale bars = 100 mm.

Table 1. Morphometric (as percentage of SL) and meristic data of *Laemonema robustum*.

Specimens	Holotype*	MZUSP 125605	BMNH 1864.8.24.2	Meléndez and Markle (1997)	Range
Standard length (mm)	325	342	265		
Morphometric characters					
Head length	27.3	27.1	28.3	24.9–29.9	24.9–29.9
Snout length	8.4	8.0	8.3	6.9–8.4	6.9–8.4
Orbit diameter	6.3	5.5	7.1	5.3–7.3	5.3–7.3
Post-orbital length	12.5	14.4	15.3	12.1–16.3	12.1–16.3
Inter-orbital width	6.1	5.3	6.1	4.7–6.1	4.7–6.1
Chin barbel	4.7	3.6	4.5	3.1–5.7	3.1–5.7
Maxillary length		12.9	14.7	12.4–14.8	12.4–14.8
Pre-dorsal length	30.5	28.1	32.7	27.2–32.6	27.2–32.7
Pre-anal length	48.8	49.4	48.3	41.9–50.0	41.9–50.0
Pre-pectoral length	31.3	29.3	30,2	28.2–31.6	28.2–31.6
Pre-pelvic length	21.9	26.3	21.9	20.6–26.4	20.6–26.4
Pre-anus length		45.1	45.0	38.9–45.0	38.9–45.0
Pectoral length	21.1	20.0	20.2	17.9–21.7	17.9–21.7
Pelvic length		32.2	34.2	19.8–35.2	19.8–35.2
First dorsal-fin base	3.9	5.0	5.2	3.5–5.1	3.5–5.2
Second dorsal-fin base		57.6	58.0	55.5–66.9	55.5–66.9
Anal-fin base		47.8	52.6	45.4–52.7	45.4–52.7
Pectoral-fin base	4.7	4.7	5.7	3.5–5.4	3.5–5.7
Depth at first dorsal-fin origin	27.3	28.0	29.8	21.9–27.7	21.9–29.8
Depth at anus		26.3	27.3	21.7–27.5	21.7–27.5
Depth at anal-fin first ray		25.0	27.2	21.0–27.6	21.0–27.6
Second dorsal-fin ray length	21.1	15.5	22.6	15.4–25.9	15.4–25.9
Caudal peduncle height		2.9	3.4	2.4–3.5	2.4–3.5
Meristics					
Dorsal-fin rays	5 + 50 or 51	6 + 52	6 + 48	6 + 50–57	6 + 50–57
Anal-fin rays	48	48	48	48–54	48–54
Pectoral-fin rays	28	27	27	26–30	26–30
Number of scales above LL	ca. 13	15	15	14–19	14–19
Number of scales below LL		42	43	39–47	39–47
Lateral series of scales	ca. 126	137	133	120–150	120–150
Gill rakers		4 + 13	4 + 14	4–7 + 13–16	4–7 + 13–16

*The holotype was lost while on loan according to third author, senior curator of The Natural History Museum Fish Collection; its data is based on the original description of the species by Johnson (1862).

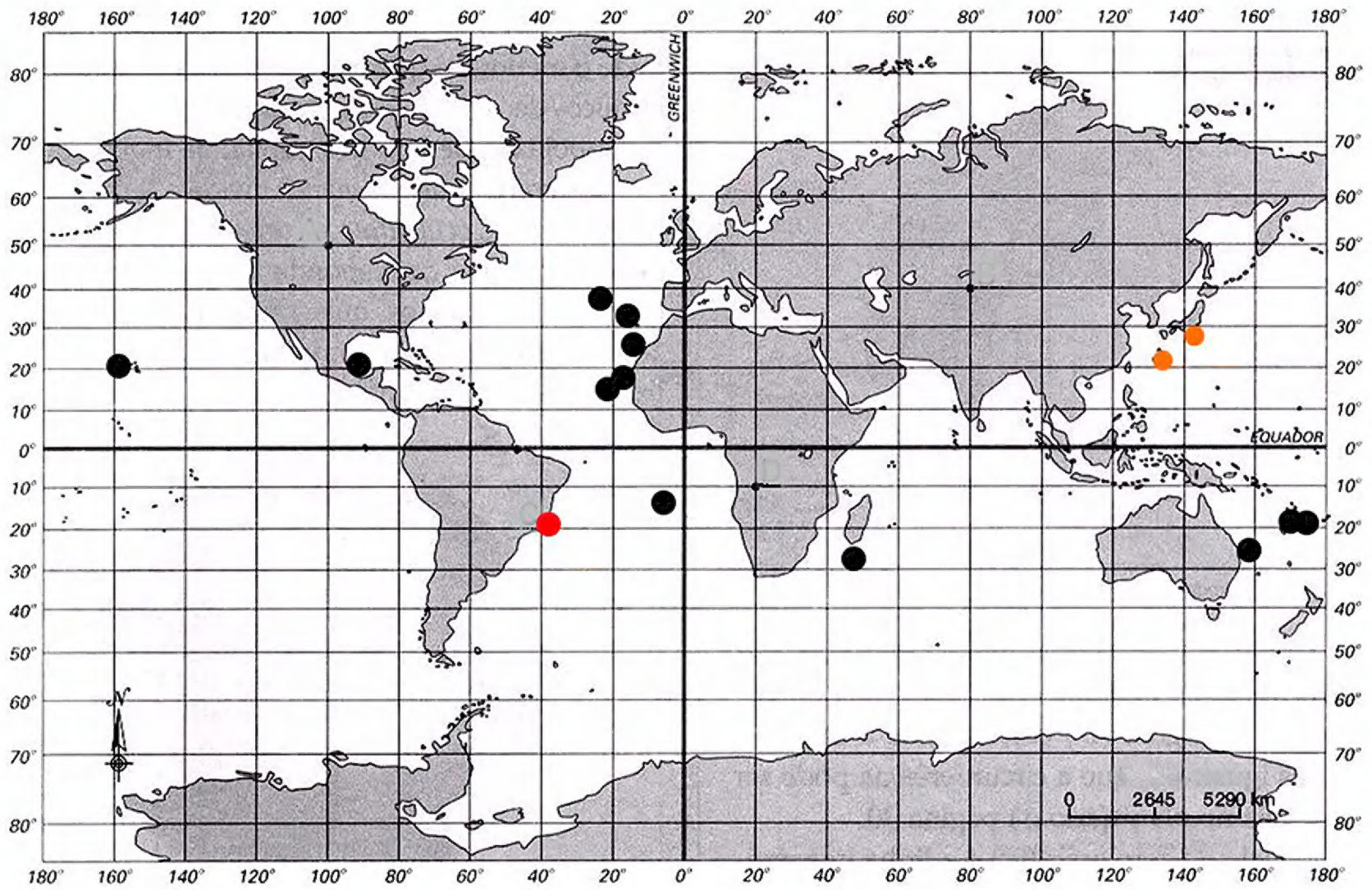

Figure 2. World records of *Laemonema robustum*. Black dots: previous records; red dot: Brazilian record; orange dots: *Laemonema filodorsale*.

Identification. *Laemonema robustum* is distinguished from its Atlantic congeners by its robust, deep body (21.9–27.7% SL), with deciduous scales; pectoral fin with 26–30 rays; scales below lateral line 39–47; pelvic-fin length 19.8–35.2% SL; first dorsal fin with 6 rays.

Description. Based mainly on Johnson (1862), Günther (1862), Meléndez and Markle (1997), and Iwamoto and Cohen (2016), complemented by our observations of examined material and the Brazilian specimen. Morphometric measurements and meristic counts are given in Table 1. Body stout tapering to narrow caudal peduncle, deepest at the origin of the second dorsal fin; nape elevated; head large, robust; mouth large, almost terminal, upper jaw overlaps lower. Maxillary reaching middle to end of orbit, with one or two external rows of strong caniniform teeth, followed by at least seven rows of smaller canine-like teeth; a gap at symphysis. Vomer with caniniform teeth on a rounded patch. Dentary with outer row of spaced strong canine-like teeth, followed by one or two rows of smaller teeth and an inner row of small teeth; a small gap at dentary symphysis. Snout short, depressed, obtuse, rounded, the two nostrils close and widely separated from eyes. Orbit diameter wider than interorbital width, shorter than snout. Chin barbel slender, shorter than orbit. Opercle ending in an obtuse point, covered by skin. Postorbital length about half of head length. Predorsal fin length about equal to prepectoral length and prepelvic fin length. Body declines in depth to caudal peduncle, which is larger than chin barbel. First dorsal fin origin slightly behind or just above pectoral fin insertion, second ray longest, reaching at least the sixth (often the tenth) ray of second dorsal fin; first ray very short and not visible externally. Second dorsal fin and anal fin long-based, fin-rays´ lengths decrease with decreasing body depth, except for a few rays near the end of the fin, which are longer than those at the middle of the fin and at the end of it, thus, given to these fins a slightly rounded posterior border; anal fin shorter than second dorsal fin. Pectoral fin base closer to first dorsal fin origin than to pelvic fin origin; distal ray reaching first anal fin rays. Pelvic fin longer than pectoral, usually reaching at least to fourth anal-fin ray, with two filamentous rays, the outer longer than inner. Caudal fin asymmetrical, short, hind border truncate to rounded, lower procurrent rays 12–17, principal rays 6, upper procurrent rays 10–12. Body covered with deciduous scales, absent on anterior part and top of snout, gular area, banchiostegal area and membrane, maxillaries, region around nostrils, all fins, and base of pelvic fins; dorsal portion of snout scaled. Lateral line almost continuous, gently arched below second dorsal-fin origin, following the upper body profile to about the middle of the second dorsal fin and becoming straight to caudal fin; anterior pores large, smaller through lateral line length, the sequence eventually shortly interrupted; number of pores ca 70. Vertebrae: Brazilian specimen, 49, precaudal 13, and caudal, 36; BMNH 1864.8.24.2, 46, precaudal 13, and caudal, 33.

Size. The largest specimen deposited in a museum collection (TFMCBM-VP/01444), caught in the Canary Islands, measured 374 mm SL, 408 mm TL and weighed 698 g, according to González et al. (2008). In the same work, the authors examined additional specimens, apparently not preserved, and the largest of those reached 428 mm TL and 396 mm SL; another specimen, collected from the Cape Verde Islands measured 43 cm TL, (Menezes et al., 2004) but we were unable to find any other references to this fish; considering the proportions related by González et al. (2008), where the SL of 35 specimens varies between 91 and 93% of the TL, the record from Cape Verde has a SL of at least 39 cm, one of the largest ever collected and, if preserved, would be the largest known to date in a collection.

Preserved specimens coloration. Body light brown to brown, belly grayish to white; gular region and branchiostegal rays white to light brown; maxillaries pale; mouth and gill cavities whitish to greyish brown; all fins usually dark brown to black except white pelvic-fin rays, pale anterior anal-fin rays and, in some specimens, pectoral-fin outer borders; second dorsal-fin ray often white distally; anus surrounded by a dark ring. One specimen (BMNH 1864.8.24.2) presented the dorsal and anal fins dark only anteriorly, the posterior part of these fins is light brown as the caudal and pectoral fins.

Live coloration. Body brown, darker at dorsum and upper head, with slightly mauve hues on body, head and fins, except pinkish to white pelvic-fin rays. Gular region and branchiostegal rays pink to orangish over a white background; maxillaries usually pale pink; belly varying from white to grey or even brown as the rest of the body. Pectoral fins often with outer borders pink to orangish red. Anal fin dark brown, orangish to pinkish anteriorly; dorsal fins dark brown, the tips of the last dorsal-fin rays eventually orangish to pinkish; second dorsal fin-ray tip pale. Caudal fin brownish, orangish distally. Anus surrounded by a dark ring.

Distribution. *Laemonema robustum* is an uncommon fish species despite its wide circumtropical distribution (Fig. 2), occurring in a depth range of 336–1200m. About 50 specimens (not including *L. filodorsale* Okamura 1982, and *Laemonema modestum* (Franz 1910), see Discussion) are deposited in museum collections, most of them from the Eastern Atlantic (Canary Islands, Cape Verde Islands, Madeira, off Mauritania, and Saint Helena Island), several from Western/Central Pacific (Japan, Australia, New Caledonia, Palau and Hawaii), and only three from the Western Atlantic (Gulf of Mexico, two, and Brazil – this paper), according to GBIF (2020), and Meléndez and Markle (1997), Menezes et al. (2004), and González et al. (2008).

Discussion

According to Meléndez and Markle (1997), *Laemonema filodorsale*, described from the Kyushu-Palau Ridge, Pacific Ocean, and *Laemonema modestum*, described

from Japan, are junior synonyms of *L. robustum*, but the authors stated that: "We tentatively treat *L. filodorsale* and *L. modestum* as junior synonyms of *L. robustum*, but note the small sample sizes and the potential that slight differences might exist". Parin and Sazonov (1990), Paulin and Roberts (1997), and Nakabo (2002) state that *L. filodorsale* is a valid species, but these authors do not compare it with *L. robustum*, as done by Meléndez and Markle (1997). Mundy (2005) in his checklist of the Hawaiian fishes, regarded *L. filodorsale*, collected at unspecified depths from Gardner Pinnacles to the Hancock Seamounts, as a synonym of *L. robustum*, based on Meléndez and Markle (1997). Fricke et al. (2011), cited both species in their checklist of the fishes of New Caledonia, but did not compare them, their data coming from literature. Finally, Fricke et al. (2019a), list both species as valid, but with a note under *L. modestum* distribution stating "if valid". In a conservative approach we consider *L. filodorsale* as a valid species and *L. modestum*, due to its similarities with the latter as well as the site of collection of the lost holotype (Japan), as a possible synonym of *L. filodorsale*. Further studies, including genetic analyses, might clarify the situation.

Our record represents the southernmost occurrence of the species in the Atlantic Ocean as well as the first from the Southwestern part of this ocean, extending its range to about 7500 km from the previously known collection locality at the Gulf of Mexico, about 3700 km from Cape Verde Islands and 3500 km from Saint Helena.

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Authors' Contributions

ACF designed the plan. ACF and JM identified the fish specimen. GM and MIGP collected data at field and preserved the specimen. ACF wrote the manuscript and made the measurements. All authors reviewed, finalized, and approved the manuscript.

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